Musical Finitude Hypothesis

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(This hypothesis is broken down into 6 sections, as shown below.)

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Key terminology: finite domain, finite domain movement, finitisation, infinite-finitude spectrum, common practice period, auditory relativism, auditory evolution, auditory practicality, inter-related dimensions of music.

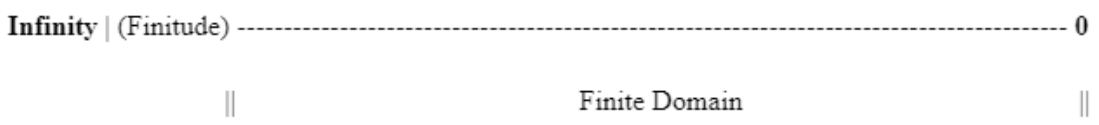
(1) Overview

This hypothesis of Musical Finitude explores the notion that— under the constraints of human existence— music becomes finite, although, in itself, it is an infinite resource. Whilst finite, it exists in what I refer to as the *finite domain*. Within this finite domain, music can experience drastic movement, shrinkage, and growth (in terms of possibilities), but this is all dependent on certain factors.

Here's an example: realistically, music is composed of a variety of frequencies, and scientifically, these frequencies are infinite. *(It must be noted that the frequencies' boundaries exceed the human hearing, and therefore can be classed as 'tending to infinity', though in reality is prohibited by practical limits of frequency generation. Put simply, frequencies are theoretically infinite, but not practically infinite. But for the basis of my argument, we can presume that they are boundless.)* If music is composed of infinite frequencies (and thus, pitches), as well as infinite rhythms too (as there are boundless combinations of rhythmic patterns), then it can be concluded that music itself is infinite. However, by applying the finite nature of human existence to music's infinite qualities (e.g a human's finite hearing range), it is possible to theorise that music is finite in its combinations. This hypothesis report will explore this exact notion, and the effects of it.

The hypothesis of Musical Finitude focuses on the process music undergoes to transform from infinite to finite (**Finitisation**), but more so, the process it undergoes to travel across the finite domain towards (or away from) zero (**Finite Domain Movement**).

Infinite-Finite Spectrum - this refers to the model below.



I posit that there are four factors affecting this movement: **Auditory Capabilities**, **Auditory Relativism**, **Auditory Evolution**, and **Auditory Practicality**.

Auditory Capabilities - this refers to the boundaries of the human body and its abilities.

Auditory Relativism - this refers to socialisation and how it has influenced our standards and requirements of music.

Auditory Evolution - this refers to the changes music experiences over a period of time.

Auditory Practicality - this refers to the application of logic, finance, technology, etc. in regard to producing music.

These factors can be categorised based on whether they affect finitisation *or* finite domain movement. This can be seen below.

Factors Affecting Finitisation	**Factors Affecting Finite Domain Movement**
• Auditory Capabilities • Auditory Practicality	• Auditory Relativism • Auditory Evolution

(2) Proving Finitisation Through The Ten Interrelated Dimensions of Music

These four factors (above) are all human-caused (directly or indirectly), and two of them have led to the transformation of music from infinite to finite (finitisation). (These two are Auditory Capabilities and Auditory Practicality.) I discussed that music is infinite because it is based on infinite features (infinite pitch, infinite rhythm, etc.), but by making those features finite, music itself becomes finite, and thus, the hypothesis of musical finitisation.

Interrelated Dimensions of Music (IDM) - this refers to the (ten) components of music, including pitch, articulation, dynamics, structure, harmony, instrumentation, rhythm / tempo, texture, tonality, and timbre.

Various sources (Department for Education 2016; Minute of Listening 2020; BBC Bitesize 2023; The Deanery 2024) provide different stances on the definition of the IDM, but by collating all definitions, I have established my own description of the IDM. Some would

argue this questions the validity of my research– if even at the basis of my research, I have created my own definition– however, all of the cited sources suggest music is defined by less than ten dimensions. By exceeding ten in my own definition, I widen my scope– with the finitisation proof, and thus increase the validity. The main source that I have used to obtain the interrelated dimensions of music is Levitin, D. (2006) 'This Is Your Brain on Music: The Science of a Human Obsession'. In Chapter 1 (p.15), Levitin explores the dimensions, specifically: pitch, rhythm, tempo, contour, timbre, loudness, reverberation, metre, key, melody, and harmony. Levitin defines reverberation as the distance between the source of music and the listener. Though he is correct, I believe that this isn't a fundamental dimension of music, given that it refers more so to the delivery of the music ,rather than the music itself. Secondly, Levitin's inclusion of contour is defined as the "overall shape of the melody". For me, contour is, therefore, a dimension of melody, rather than music, so I discounted it as a dimension. Furthermore, I do not consider melody itself as a dimension of music, but rather a composition of other dimensions (specifically pitch and rhythm). The dimensions should attempt to strip music to its fundamental elements; melody is holistic and subjective, and therefore, I discounted it as a dimension. What Levitin calls "loudness" is synonymous with dynamics, and "key" is synonymous with tonality. According to Levitin, "metre is created by our brains by extracting information from rhythm and loudness cues, and refers to the way in which tones are grouped with one another across time". In my opinion, metre is another subjective element of music– one that is composed by individual perception, rather than an actual scientific dimension of musicology. Therefore, I discounted it. Furthermore, even if metre was a scientific dimension, I would argue that the way in which it is extracted from "rhythm and loudness" suggests that it isn't a fundamental dimension itself, but rather it is a composition of other dimensions (specifically rhythm and dynamics). The only other difference between my definition and Levitin's definition is my addition of articulation, structure, instrumentation, and texture. Articulation, instrumentation, and texture are somewhat built from other dimensions (dynamics, timbre, and harmony– respectively), however I argue that there is something more to them that makes them worthy of their own categorical dimension. In terms of structure, it could be argued that aspects of Levitin's "contour" dimension are existent here. Nevertheless, I believe that the organisation of a piece of music (whether than be holistically or in terms of sections) is vital in the creation of music, as every piece of music has a structure (even if it is free form for example). Away from Levitin's ideas, it must also be noted that I have categorised rhythm and tempo under the same dimension, despite their function being entirely different to one another. I believe that they influence one another heavily, and the finitisation of one of them is very similar (if not identical) to the finitisation of the other, and so I have categorised them as the same dimension.

As stated before, the IDM (above) are all infinite in terms of science, but under the control, influence, and service of humans, they become finite. (It must be noted that the finitisation of each dimension of music is directly controlled by either of two of the factors: Auditory Capabilities and Auditory Practicality.)

So let's start by proving all the dimensions of music are finite while under the constraints of human existence.

Pitch

Pitch refers to the quality of a sound governed by the rate of vibrations producing it. It is the degree of "highness" or "lowness" of a tone. The human hearing capacity (20-20,000 Hz) already eliminates the idea of an infinite range of frequencies (and thus pitch), because there is only a certain amount of pitches humans can actually hear. (The finitisation of this dimension is controlled by Auditory Capabilities.)

Articulation

Articulation refers to the way in which a pitch or note is sounded (including accents, staccatos, legatos, etc.). Though the spectrum of articulation seems broad, it most certainly isn't infinite. Humans are capable of sounding notes (using their instrument) in a variety of ways, but this doesn't necessarily mean that these ways are boundless. If the human body's motor systems have their capabilities, then so does the way it articulates music. Moreover, devices of articulation (such as staccato and legato) often refer to shortening or increasing the length of the note. Realistically, there is only so far this can go before the note is inaudible, let alone impossible to play. So even in a world where technology has boundless potential, articulation has its boundaries in regards to practicality of hearing. (The finitisation of this dimension is controlled by Auditory Capabilities.)

Dynamics

Dynamics refers to the volume of the notes when they are sounded. Although we could spend time discussing the volume capabilities of instruments, and the boundaries of energy usage when this is done (if done by machinery), it is logical to understand that there is a limit to how soft or loud music can be played. There are extremes to both ends, and no matter what personal preference begs to say, there will all be two ends of the volume spectrum that the human race can agree on as *extremes*. Furthermore, certain extremes will cause hearing loss, and thus the inability to listen to music (NIDCD, Noise-Induced Hearing Loss 2024). Therefore, the volume of music is a finite spectrum. (The finitisation of this dimension is controlled by Auditory Practicality.)

Structure

Structure refers to the order in which sections present themselves in the piece of music. Given that there is no theoretical limit to music's length, the combinations of sections within it can therefore be infinite too. However, proportional statistics state that music will always be limited in length in order to facilitate the needs of humans. In Western society, music is

often designed to be short and memorable, allowing for more listeners to enjoy it. Not only this, it is theoretically impossible to *write* infinite music, and practically impossible too. Finally, if music could last an infinite length, with the help of generative AI, the proof that the other interrelated dimensions of music are finite suggests that material would eventually be recycled in this hypothetical, infinite piece of music. Therefore, theoretically, structures are finite. And if this isn't enough to prove structural finitude, it is physically impossible to listen to this hypothetical, infinite piece of music (given finite human capabilities such as lifespan, attention span, etc.), therefore whatever *is* listened to will surely be listened to in slots, time-stamps, or periods, theoretically then dividing this hypothetical piece into individual songs; this supports structural finitude further. *(It must also be noted that there are predominant structures that align with Western preferences, including binary, ternary, rondo, sonata, verse-chorus, etc.)* (The finitisation of this dimension is controlled by Auditory Practicality.)

Harmony

Harmony refers to the sound of two or more notes sounding together. There are an infinite number of possibilities, ranging from the amalgamation of two adjacent notes, to the amalgamation of two notes of either end of the frequency spectrum (though arguably there isn't one, given its infinite properties), to the amalgamation of an infinite number of notes derived from the infinite number of frequencies. However, given the constraints and parameters of human existence, there is only a selection of pitches available for human use. This notion is explored in the *pitch* section above. Therefore, if there is a finite number of possible notes, then there is a finite number of possible combinations of these notes. Therefore, harmony is finite. (The finitisation of this dimension is controlled by Auditory Capabilities.)

Instrumentation

Instrumentation refers to the specific devices used to create music. There is no scenario where this is infinite. (Tangible) musical devices exist as a result of finite materials. Matter which exists on our planet is finite, and therefore the instruments that are created with it become finite in their possibilities too. Even if we were to entertain the possibility of infinite matter, not all matter can produce sound (despite any efforts to arrange it), although most matter can. (Either way, this reduces the possibilities further.) Therefore the specific items used to create and perform are a finite resource. (The finitisation of this dimension is controlled by Auditory Capabilities.)

Rhythm / Tempo

Rhythm refers to the placement of sound in time. Given that time is an infinite concept, the placement of sound within that infinite concept must also have infinite possibilities. However, rhythm is significantly dictated by tempo. Hypothetically, if one was to place sound in a trillion years time, the silence that precedes it and the sound itself would be considered a rhythm. Adding another sound somewhere in the middle will give us a rhythmic

pattern. However, if we were to increase the tempo of this rhythm, we could get it to last seconds, rather than a trillion years. Furthermore, the spectrum of tempo itself is finite; if one was to increase the tempo of a piece of music to the point where it is heard as one single pitch, it can be argued that the tempo has reached its limit (and anything with a limit is considered finite). As well as this, rhythm itself must be approached with some logic too. Rhythmic patterns must obey human lifespan and attention span, meaning that (in a way) rhythm is finite in its possible combinations. (The finitisation of this dimension is controlled by Auditory Practicality.)

Texture

Texture refers to the varying layers of sound within a musical piece. The text of a piece can be referred to as monophonic (one layer), homophonic (more than one layer of unequal power), and polyphonic (more than one layer of equal power). Theoretically speaking, there isn't a limit of how many layers can be combined to create music. However, it is logical to assume that, if we take into account the sound that would be generated by an infinite amount of layers combined, texture is finite, given the impracticality of building music too high and compact. Similarly to a building, it is theoretically possible to keep constructing higher and higher, but given that the building will become more unstable as it ascends, it can be deemed impractical to continue construction. Therefore, the texture of music is finite. (The finitisation of this dimension is controlled by Auditory Practicality.)

Tonality

Tonality is the key or pitch centre of a piece of music, and its overall sonic character (quality or style). Around the world, there are many tonalities that can be applied to a piece of music, and in some cases, there are no tonalities applied; this is called atonal music. However, given that pitch is finite (in relation to human constraints), there can only be a finite amount of pitch centres (or tonic notes) from which the music is built. Tonality is the scaffolding and foundations of music, but with only a limited amount of material, the types of scaffolding / foundations are not infinite. *(It must also be noted that atonal music is specifically a lack of tonality, therefore it does not determine the finite / infinite nature of tonality.)* Therefore, the tonality of music is finite. (The finitisation of this dimension is controlled by Auditory Capabilities.)

Timbre

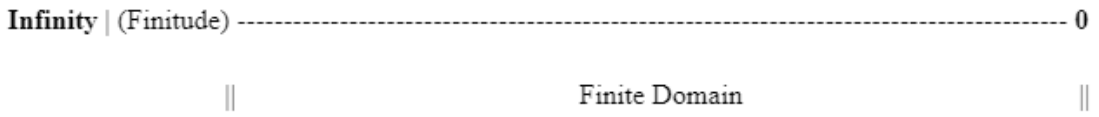
Timbre (or *sonority*) refers to the unique sound or tone quality of different instruments and the way we can identify instruments as being distinct from each other. Given that the combinations of matter are not finite (as previously discussed), there are only a limited number of instruments. Of these instruments, there are only a limited number of sounds or tones that they can make. No matter how many strategies are applied to making an instrument sound differently, there will always be a finite number of combinations. Timbre is built upon

the characteristics of matter (whether that be the quality of a male's voice or the quality of a guitar's strings). These characteristics could only be infinite if the matter itself was infinite, but this is not true, therefore timbre is finite. (The finitisation of this dimension is controlled by Auditory Capabilities.)

Finitisation Conclusion

Now that we have proven that the ten interrelated dimensions of music are finite, it can be presumed that music itself is finite too, under the constraints of human existence. So far, on the Infinite-Finite Spectrum, music has been finitised.

(Music – Thus Far) ↓



However, with the introduction of the remaining factors (Auditory Relativism and Auditory Evolution), the hypothesis can be taken a step further to suggest that music does not sit in an immobile state upon the finite domain (as suggested so far). Instead, music can vary in its position, and will move frequently depending on Auditory Relativism and Auditory Evolution. Let us discuss both individually.

(3) Factor-Dependent Finite Domain Movement: Auditory Relativism

On a more detailed level, Auditory Relativism refers to the cultural differences around the planet that dictate the disparities in music globally, as an average. To put into perspective, the typical music heard in China is completely different to that which is heard in the United Kingdom. Therefore, there must be a difference in how music is approached. If this is true, then one approach will minimise music's possible combinations more so than the other.

This concept is supported by the octave. An octave is the interval between one musical pitch and another with double its frequency. For example, if the frequency of a note is 440 Hz (the pitch A4), the note an octave above (A5) would have a frequency of 880 Hz. This concept of the octave as a relationship between pitches is consistent across musical cultures, given its scientific foundations. However, different musical systems divide the octave differently. By differing the process across the globe– of dividing the interval between two frequencies (where one is double the other) to create a system of notes– we are left with disparities in musicologies worldwide. Logic would say that a culture that possesses a greater number of divisions of the octave is destined to have a greater number of combinations of musical melodies (whereby a melody is defined predominantly by pitch).

In Western society (i.e European), the division of the octave is known as a 12-tone equal temperament. This means that the octave is divided into 12 semitones of equal size; all intervals between each consecutive note are the same. However, in Indian music (specifically, Hindustani and Carnatic), it is quite different. The octave in Carnatic music is divided into 22 *shrutis*, though only 7 notes are commonly used (Sa, Re, Ga, Ma, Pa, Dha, Ni). These 7 notes align with the Western 7 notes of a diatonic major scale: Do, Re, Mi, Fa, La, So, Ti. However, if a Western composer is challenged to write a piece of music, and so is a Carnatic composer, the Western composer is limited in their chromatic use. A Western composer, if challenged to write a piece within a major key, has 5 chromatic notes to choose from. A Carnatic composer, if challenged to write a piece within a major key, has 15 chromatic notes to choose from. These chromatic notes, in Carnatic musicology, are referred to as microtonal variations.

So far, this appears relatively comprehensible. However, in Carnatic musicology, chromatic notes aren't a binary option like they are in Western music. While it's true that Carnatic music employs microtonal variations and a more extensive pitch palette due to the 22 shrutis, this does not translate directly to a simple count of chromatic notes as in Western music. Instead, the shrutis provide a range of pitches between the main notes (swaras), allowing for intricate ornamentation and variations rather than strictly defined "chromatic" notes. Furthermore, Carnatic musicology follows a more fluid tonal framework, meaning that when I gave the scenario of the composer "writing with a major key", it is likely that a Carnatic composer would not be bound by keys and scales. In fact, it is likely that they would use what is known as the Raga System. Each raga consists of specific notes (swaras) and has distinct rules for how these notes can be used. A raga can evoke different emotions and moods, which are more nuanced than the binary classification of major and minor (as seen in Western music).

By this point, an impression is created that Carnatic music has a greater number of possibilities than Western music, given its wider spectrum of note divisions and the fluidity of how they are used. However, this would be an incorrect assumption. In Western music, there is a stronger emphasis on harmony (with chords and progressions forming the backbone of compositions), whereas in Carnatic music, the emphasis is on the melody and improvisation rather than the accompanying harmony; the focus is on the raga rather than the chord progressions, so perhaps this limits the possibilities of music, given that the harmony is limited by cultural choice. Furthermore, Western music has a far greater range of instruments, stretching from synthesises (in the technology industry) to harpsichords (in the orchestral setting), and on top of this, Western music has incorporated influences from various cultures and genres globally, compared to Carnatic music which focuses more on cultural significance (given its deep roots in South India), therefore making it associated with spirituality and devotion in the context of temple music.

Although, once again, this can flip the other way round. Western music is heavily restricted to time signatures and predictable patterns, whereas Carnatic music employs complex rhythmic cycles (talas), which can have varying lengths and patterns. Talas are often more intricate and can involve subdivisions of 5,7, or 9 beats (for example). There is also a heavy emphasis on

interpersonal relationships in the context of teaching and sharing music, compared to Western society where it is often taught online, in schools, or via paid lessons.

The point is clear: though we are all human, and scientifically, we are all given the same dimensions of music, the way we interpret music in our specific culture will vary the way we create it and mould it.

Therefore, in the context of musical finitude, the cultures with the stricter rules and systems of controlling the interrelated dimensions of music are the cultures who have less combinations of music, and therefore perhaps might be the cultures that are suffering from creating new material to align with these systems.

This subsection of my hypothesis– that is associated by the term "Factor-Dependent Finite Domain Movement" – regards the notion that if we apply Auditory Relativism to the interrelated dimensions of music, and then apply those disparities in dimensions to the finite domain, we are presented with the concept that music's position upon the finite domain spectrum varies depending on the cultural context.

As seen previously, this doesn't necessarily mean that an increase of parameters (or factors) will decrease the possible combinations of music, for it could do the opposite. An example would be Carnatic rhythm; it is more fluid and complex than Western music, so the musical combinations increase, making the combinations 'tend to infinity'. In theory, this would shift Carnatic music further to the left side of the spectrum. However, Carnatic instruments are potentially not as broad as Western instruments, so this would shift Carnatic music further to the right side of the spectrum. This constant movement of Carnartic music upon the spectrum is purely due to the introduction of different factors and parameters, hence the hypothesis title: "Factor Dependent Finite Domain Movement".

If proven valid, and the concept of finite domain movement is true, then a question arises: can a culture implement so many systems that musical combinations become exhausted? Could a culture that divides an octave only four ways be extremely limited in its potential to create music? And lastly, is this hypothetical situation merely theoretical, or is it in practice today?

Let us consider that we create our own musical system, whereby we divide an octave into 4 equal parts. Let's say our octave is between A4 and A5 (440 Hz – 880 Hz). If we were to split it into 3 parts, the difference between each note of our system would be 4 semitones. We would be left with A4, C#4, F4, and A5. By dividing our octave this way, we have limited ourselves to only 3 individual notes. Now imagine, in our musical culture, that a melody consists typically of crotchets and is found almost always in a time signature of 3/4, whereby the average melody lasts for 3 bars (9 crotchets). Supposing that we use all of our notes more than once, there are 19683 total possibilities for our melody.

Now imagine that we create our own musical system, whereby we divide an octave into 30 equal parts. *(Given the conventions of the Western world I have been socialised by, and my inexperience of working with microtones, I fail to provide the specific notes within our new*

system, however there are 30 notes.) Let's say that a melody, in our musical culture, typically consists of quavers and crotchets and isn't found within a time signature. Let's say that, on average, 50% of the melody will consist of quavers and 50% of the melody will consist of crotchets, and a typical melody lasts 20 crotchet beats. There are 265252859812191058636308480000000 total possibilities for our melody.

The purpose of these two scenarios is to demonstrate the disparities in musical interpretation across the globe. However, the number of possibilities is extremely invalid, given that not all melodies are the same, and therefore by making assumptions about the statistical proportion of rhythms used, as well as the amount of pitches in the system used, validity is drastically decreased. However, as a rough model, it illustrates the way in which different cultures interpret the same dimensions of music. And as a result, it can be theorised that different cultures are limited to a different number of combinations of music.

(4) Factor-Dependent Finite Domain Movement: Auditory Evolution

Interpreting the interrelated dimensions of music differently is not a phenomenon exclusive to different cultures. Instead, it can occur within a culture over time. I refer to this as *Auditory Evolution*.

Let's delve into a case study where finite domain movement occurs, as a result of Auditory Evolution.

Finite Domain Movement Case Study: Western Music

So far, we have considered the finite domain movement of different cultures, *relatively* speaking. However, it is equally important to explore the journey a specific culture of musicology undergoes in itself. Not all cultures are fixed in terms of their musicologies, and therefore each undergoes movement across the finite domain independently.

Let's consider Western music as a timeline.

Dawn Of Humans

The evolution of sapiens can be split into four epochs: prehistory, hunter-gatherer, farming, and towns.

At the beginning of this timeline, around 530,000 years ago, humans had one instrument: the voice. This was a result of a horseshoe-shaped hyoid in the neck– used for communication. The hyoid bone facilitates a broader vocal range by enabling the precise movements of the tongue and larynx necessary for producing multiple pitches. This anatomical feature is one of

several adaptations in humans that support complex vocal communication. And as a result, multiple pitches could be achieved. (This range is dependent on the sex and anatomy of the individual.) Therefore, the possible combinations of music were slimmer then, compared to now, given that there was only one single instrument. It could be argued that this stage of evolution is the first milestone of musical finitisation, in relation to pitch. From here, the use of lithic instruments (such as stalactites) was introduced. A famous example are the rock gongs in Tanzania (though this is outside of the border of western society). The next milestone in instrumental evolution was the discovery of bone flutes, used by hunter gatherers. These were found in Hohle Fels, Schelklingen, Germany– a group of southern German caves– and were made from vulture bones. This means humans could manipulate sound and pitch, developing the concept of articulation and perhaps even dynamics, however the evidence of this is minimal, as biodegradable materials were often used.

Up until 11,000 and 12,000 years ago, nomadic people lived with the sole purpose of fishing, hunting, eating, and reproducing. They were always travelling, and so luggage was light or non-existent in most cases. Therefore, music had to be portable; ideally, just a voice or (if not), a very light flute or small percussive instrument. Given the limited instrumentation, music is limited.

However, in the 'farming' epoch, lasting until 6,000 years ago, the mindset changed, and people began to settle. Humans began to focus on the circle of the seasons and life, therefore repeatable work was invented. Previously, it is likely that every piece of music that was played was short, given that it would've been played between hunting and survival tasks. Each piece would've also been different to one another, as there would've been no focus on maintaining repetitive work. Therefore, the variety of music is much greater. However, with the introduction of settlements and farming, the structure of music becomes as cyclical as life itself, limiting the combinations. These pieces would've likely been performed in rituals and gatherings.

Up until 5,000 years ago, the 'towns' epoch occurred, and the notion of 'settling' in a certain place became forefronted further. Instruments could become heavy, because humans would establish permanent roots in a particular place. Bells, gongs, harps, and lutes (which would've once been damaged over the journeys between places) begin to be crafted. Therefore, with a wider variety of instruments, the possible combinations increase too. Music's function changes too, as the growth of social hierarchy emerges. Music no longer is purely for enjoyment and entertainment, but now instead, it has a role to serve. As well as this, musicians become professionalised, and their job is to create music to be listened to for people with leisure. This is the origin of concerts.

During this time, the overall movement on the finite domain is towards zero.

<u>The Middle Ages</u>

The Middle Ages approximately lasted from 400 to 1450 A.D. At this stage, society is more sacred than ever before, and so there is a large emphasis placed on church music. Knights

accumulated their reputation through music, in addition to their status as warriors. We have the introduction of two main genres: Gregorian Chant and Organum. (By limiting music to an average of two genres, the systems that mould it become stricter and more rigid. This is perhaps one of the first significant milestones of finite domain movement.)

Gregorian Chant was entirely monophonic *(single melodic line without counterpoint or accompaniment)*. It was performed in Latin for the Roman Catholic Church, and was designed to be sung alone or in a group. It possessed no time signature, and was known for being calm and relaxing. Here, we introduce the notion of 'Factor-Dependent Fluctuation of Finite Domain Movement'. Let's look at the Gregorian Chant's features (and what they could entail) in more detail. Firstly, by limiting the music to monophony, there is no potential for accompaniment or harmony. Therefore, this doesn't *limit* one of the dimensions of music, but rather *eliminates* it, resulting in a drastic movement across the finite domain. The emphasis, therefore, is placed entirely on *melody*, specifically pitch and rhythm. The range of this melody, as well as the rhythms used within it, needed to facilitate those performing it (often men and boys), as drastic intervals, pitches, or rhythmic patterns would've been difficult in performance, especially in regard to the 'calm' and 'relaxing' traits it possessed. However, the fluctuation of finite domain movement occurs specifically with the lack of a time signature. This meant that there was complete freedom in how the pitches and rhythms were arranged, allowing for a counteracting movement *up* the finite domain, so to speak. These opposing factors (monophony vs. a lack of metre) create opposing movement on the spectrum, as one factor limits music, and the other idea doesn't.

Organum was developed between 700 and 900 A.D, and is a similar chant to the Gregorian, however the melody is polyphonic (several melodies, each in counterpoint). By featuring two or more independent melodic lines sung simultaneously, a richer and more complex sound is created. Organum often used Cantus Firmus (pre-existing Gregorian chant melodies to create the basis of the polyphony), as well as more elaborate melodies. The use of polyphony allowed for the development of harmony as a musical dimension; organum used parallel motion (fourths and fifths), consonant intervals, contrapuntal techniques, and an overall modal framework. And while the early organum maintained some flexibility, it began to establish clearer rhythmic patterns, compared to the free metre and rhythm of Gregorian chants. Therefore, the fluctuation occurs similarly here, but the opposite in its factors. In short, polyphony allows for a greater use of harmony (a dimension that wasn't used in Gregorian), yet the more rigid metre disallows for improvisation, fluidity, and expression, as well as irregular rhythms. As a result, the combinations decrease once again. However, this movement is opposed by the introduction of polyphony.

In 1150, composers began to develop a musical language, where they could measure rhythms, notes, definite time values, pitch values, and metre. Up to this point, a variety of modes were used. *(There are seven modes, which are based on ancient Greek and Gregorian music. They include: Ionian, Dorian, Phrygian, Lydian, Mixolydian, Aeolian, and Locrian. Of these seven modes, the Ionian (major scale) and Aeolian (natural minor scale) are the most commonly used.)* The introduction of musical notation significantly influenced the change from utilising

all seven modes to utilising only a few. This restriction of modal frameworks occurs with rhythm too, as melodies are forced to sit within bars, bound by established time signatures. This doesn't necessarily make music immediately minimal in its combinations, but is still a drastic change from total freedom to a rigid system.

During this time, the overall movement on the finite domain is towards zero.

Renaissance

The Renaissance period lasted approximately between 1450 and 1600, and involved a few key changes: print press, sequencing, and a capella. The printing press was invented in 1440, but its effects didn't come into play until the renaissance period. It allowed a greater accessibility to music education, allowing wealthy members of society to understand the dimensions of music. A vast number of songs were written, potentially more than ever before, as vocal music became the most significant genre of music. The music is still calm, with little to no dynamics, rhythm or tonal extremes. There is a large emphasis on the use of vocals and lyrics to create a mental image for the listener, as though the music is narrating a story. Most importantly, sequencing is used, meaning that melodies are repeated at different vocal tones, allowing for greater repetition of musical ideas. Finally, a cappella (singing without instrumental accompaniment) allowed for vocal experimentation with an expanded and developed range. This created an emphasis of individuality, rather than conformity. Therefore, fluctuation occurs again, as the pitch range increases, allowing for more possible combinations, whereas the printing press allows for music notation (and the restraints that come with it) to be published and spread nationwide.

There are two branches of Renaissance music: sacred and secular. With the rise of individuality, there is a branch of society that ventures away from religion, creating individual, independent, and new styles of music.

Sacred music was centred heavily around the mass and motet. *(A mass is a polyphonic, choral composition featuring five distinct sections. A motet is any Latin choral composition, in sacred Latin language, that does not align with the features of a mass, for example it may not have five sections.)* This branch of Renaissance music continues to establish rigid structures to music, however its polyphonic texture could be evidence of its vast potential possibilities.

Secular music was centred heavily around madrigal music. *(Madrigal music is a monophonic or polyphonic composition that accommodates various solo vocalists, with lyrical and musical themes of love and nature. It always required a specific occasion.)* By allowing different types of textures in the piece, there is more freedom, as well as the idea that it can be built with different themes and intents. These themes allude to the idea of boundless lyrical possibilities, signifying a great shift towards infinity of the finite domain. However, madrigal

music was controlled by the more predominant branch of society: religion and religious people. This disallowed the music to be performed freely, and instead had to fit a certain purpose. This limited the freedom of music significantly.

As well as the growth of vocal compositions, there was an emphasis on instrumental music too. Given that access to music education was a lot easier for nobles, instrumental music grew significantly in popularity. Popular instruments included harps, organs, and lutes; these were used by solo artists. By reintroducing a focus on instrumental music, there is perhaps a growth in the possibilities for pitch, dynamics, and expression (however these factors weren't experimented with until later on).

Overall, while the Renaissance period did introduce greater freedom in musical expression, it also maintained certain restraints through established forms and conventions. This duality ultimately laid the groundwork for the further evolution of music in the Baroque and subsequent periods, allowing for even more experimentation and creativity.

During this time, the overall movement on the finite domain is negligible, so unaccounted for.

Baroque

The Baroque period lasted between 1600 and 1750, and involved the introduction of the opera, terraced dynamics, and rigid tonal frameworks. In this period, texture is predominantly polyphonic, and this is often a result of J.S Bach's works, as a lot of his compositions involved three-part harmony and counterpoint. The Baroque era also introduced western society to operas, with Jacopo Peri's 'Euridice' of 1600 being generally regarded as the earliest surviving opera, despite 'Dafne' of 1597 being considered the first too. A lot of musical compositions pulled away from the idea of consonance, and began to incorporate dissonance into their music through suspension, tension, and resolution (a common musical strategy to create emotion). The shrinking usage of the modes finally stops, and the major and minor scales become the tonal basis for all music. The popularity of string instruments, including the violin, grew dramatically, with its invention in the late 1500s and mass introduction in the 1600s. Dynamics are used but they are terraced, meaning there is no gradual change between two opposing volumes. This is due to the harpsichord– a popular Baroque instrument, known for forming the basso continuo of most pieces. It was incapable of making gradual changes, due to its binary mechanics, and so the rest of the ensemble would follow. Finally, music remains a servant for the wealthy members of society, and is written and performed for occasions, gatherings, or celebrations.

The introduction of new instruments, new forms of forefronting music to the people, and the use of chromaticism and dissonance allows for greater possibilities of music. Arguably, these drastic changes now outweigh the constraints applied to western music (e.g tonal frameworks).

For the first time, the overall movement on the finite domain is towards infinity.

Classical

The classical era, lasting between 1750 and 1815, was caused by political and social change. Between 1789 and 1799, the French Revolution ignited a spark of western rebellion, allowing for the middle class to rise, and the 'inferior' members of society to express their emotions in the form of patriotic songs and music for political rallies. There was a major emphasis on freedom and equality. The piano was invented around the year 1700 and replaced the harpsichord due to touch-sensitive mechanics that allow it to eradicate terraced dynamics. Musical compositions became heavily based on binary and tertiary structures, and different ensembles began to grow (moving away from simply just chamber music). In concertos and sonatas, there are movements and sections (respectively), allowing for contrasting ideas. Mozart's contrast in emotions over the period of his life are reflected in his music; this wasn't done often by composers. The optimistic, cheerful, and playful compositions that he wrote as a teenager (e.g Piano Sonata No.4 in Eb Major) completely contrast to the requiems he wrote on his deathbed. Music's purpose became to gain attention and to be noticed. So far, music is continuing to accelerate in its possibilities towards infinity on the finite domain, however a regression occurs to homophonic textures of simple harmonies and accompaniments. This occurs in symphonies (compositions for orchestra consisting typically of four movements). Opera continues to rise.

Although there is a greater freedom in music, the restraints and systems in place continue to remain rigid. The tonal framework is entirely based on major and minor scales, meaning the music is predominantly diatonic. There is a slight regression to consonance, as less pieces use dissonance and chromaticism, reinforcing a sense of stability and predictability. The melodies are often lyrical and symmetrical, following balanced phrases. The mostly homophonic textures disallow counterpoint and the use of several melodies simultaneously, limiting the harmonic language.The pieces are no longer free-form at all. Instead, they follow either sonata, binary, tertiary, rondo, or theme and variation structures. These forms provided a framework that composers adhered to, ensuring a sense of order and predictability in compositions. The Classical orchestra became standardised in size and instrumentation, with clear division of roles among strings, woodwinds, brass, and percussion. This organisation of orchestral forces established boundaries in terms of timbre and ensemble writing. Rhythmic patterns were generally regular and predictable, often adhering to common time signatures (e.g 4/4 or 3/4). Finally, although there was a great emphasis on the expression of individuality, there was also a reliance on tradition, limiting the extent of innovation, and creating a sense of rigidity.

Therefore, the movement on the finite domain is ambiguous and perhaps difficult to decide, but I would propose that the growth of ensembles, instrumentation, freedom, and dynamic potential outweighs the growth of structure and traditional rigidity, but only slightly.

During this time, the overall movement on the finite domain is towards infinity at a slower rate than before.

<u>Romantic</u>

The Romantic era lasted from 1815 to 1900, and is arguably an extension of the Classical era. The period focuses on developing the changes made during the Classical period. The orchestra grows, and so do instruments, allowing for louder and more grandiose performances. Various social styles emerge including Bohemianism, where individuality was the core belief, accompanied by different views, tastes, and appearances. In this period, composers (such as Chopin, Tchaikovsky, and Rachmaninoff) used *rubato*, which translates to 'stolen' or 'robbing of time' in English; it is a tempo technique that places the control over the music's speed in the performer's hands, allowing them to decelerate and accelerate the music slightly, rebelling against the rigid tempo markings. However, the main difference in this era was the developed emphasis on individualism, nature, the sublime, emotion, imagination, rejecting rationalism, exoticism, supernatural, folk culture, expression, exploration, and nationalism. Music became more fluid and free, despite the musical systems in place.

It could be argued that the Romantic era was the pinnacle of balanced perfection, possessing an equal balance between musical systems / constraints and freedom of expression. Not only were the themes broad in their topics, the harmony and structure of the compositions encompassed a variety of modulation techniques, dynamics, articulation, and textures.

During this time, the overall movement on the finite domain is towards infinity at a faster rate than before.

<u>20th Century</u>

The 20th Century, lasting from 1901 to 2000, encompassed a variety of political and social movements / changes. The focus on individualism was at its peak, incorporating all different genres and styles from across the globe. Western music begins to no longer be independent, but rather interdependent on the world around it. Secularisation *(the movement away from a sacred society)* invites boundless varieties of expression and views. Music encapsulates present, topical emotions and events, allowing for it to be a mode of communication, rather than a servant.

This freedom invited cultures to share their stories through music. A key example of this is Jazz. Its roots can be traced to the African musical traditions brought to America through the transatlantic slave trade. Enslaved Africans maintained aspects of their cultural heritage, including complex rhythms, call-and-response singing, and improvisation. In the brutal conditions of slavery, music was a way to express emotions, preserve cultural identity, and communicate. As African Americans gained more freedom post-abolition, these musical forms evolved in new environments like New Orleans, where a mix of African, Caribbean, and European cultures influenced the development of jazz. The rhythms, spirituals, and work songs of enslaved people became key components of early jazz, particularly through styles like the blues and ragtime, which laid the groundwork for jazz's improvisational nature and emotional depth. Though it can be argued this genre technically originated in Africa, it heavily influenced western society, and became one of the most popular genres of music.

As well as a growth of genres and styles, the musical systems began to eradicate. minimalism, experimental music, and atonal music grew to be very popular in the 20th Century. *(Atonal music is an example of chromaticism, and refers to music without tonal gravity or tonal centre. This means it lacks a key signature, therefore allowing all pitches in the western chromatic scale to be used.)* An example of experimental music is John Cage's "4'33", which contains none of the inter-related dimensions of music. To the average ear, the piece is complete and utter silence, however John Cage claims every performance of the piece is different; every cough of an audience member or every gust of wind outside the venue contribute to the piece's performance.

There is also a heavy emphasis on improvisation, where melodies are generated without planning during a performance. This perhaps removes any of the restraints that would usually be applied to a melody during this compositional writing stage. Performers are expected to *feel* the music, rather than apply a rational and logical approach. (However, this isn't to say that performers don't apply music theory to their improvisation, instead they just take a more free approach.)

Music is accessible globally, and music education is no longer explicitly for the elite.

In the 20th Century, pop music was commonly listened to. It's a subgenre of popular music that originated in the 1950s, and involves catchy melodies, simple structures, a short length, and an emphasis on vocals. The lyrical themes found in pop music include love and relationships, personal empowerment, party and fun, heartbreak and loss, escapism, nostalgia, social issues, and self-discovery and growth. The genre has a broad appeal, and was listened to by most members of western society in the 20th Century. It fuses genres together and uses technology to distribute it to the masses, whether that be via radio, concert, or vinyl / cassette.

Therefore, with the continuation of musical theatre, opera, and **common practice period** music (CPP), amalgamated with the introduction of new genres and musical globalisation, the possibilities for music tended to infinity. And with the introduction of atonal and experimental music, some of the restraints and systems surrounding music (that have existed for thousands of years prior to the 20th Century) are shattered and destroyed for the first time. Specifically, "4'33" provides us with a piece of music that borders human capabilities and practicality with the notion of infinite music. There are an infinite number of possible "4'33" performances, meaning that music, in a way, can be infinite.

Arguably, this era is a step too far in toying with music's potential, and perhaps it is an example that music cannot be taken too far. Instead, the constraints and musical systems in place prove to be necessary, rather than futile.

During this time, the overall movement on the finite domain is towards infinity at the fastest rate it has ever been before, perhaps even tending to infinite.

<u>21th Century</u>

The 21th Century, lasting from 2001 to present day, encompasses great ambiguity in music. On the one hand, genres continue to be fused, and there is still a great emphasis of freedom in compositional work. However, this is happening at the rate it was happening during the 20th Century.

Since the 20th Century, styles like experimental and atonal music have evolved to be incorporated in film scores, rather than being published as a successful subgenre. Due to its harshness on the ear, it isn't a predominant genre in this century. Popular music has taken over western society, with several branches including classic rock, pop, rock 'n' roll, rock, jazz, country and western, etc. A recent study showed that there are three genres that stand out as western society's top preference (with 40% or more listeners citing them as preferred genres): classic rock, pop and rock 'n' roll.

This exemplifies the drastic movement away from instrumental music– CPP– to lyrical, thematic, and topical songs.

The 21st Century includes music that is electroacoustic, technological, expansive in its instrumentation and genres, and influenced majorly by individual experiences. It is very similar to the 20th Century, however with the incorporation of technology, artificial sounds can be produced.

With the growth of film and media, music is written to represent emotions, places, characters, and settings. The melodies (that are associated with different aspects of film and media) are known as *leitmotifs*– examples include the leitmotif in Hans Zimmer's Interstellar, which is played at any drastic change in setting, tone, or character development.

Composition is now possible for all people, given the accessibility of music education and technologies such as DAWs or musical notation softwares.

However, it is easy to presume that the movement here (on the finite domain) is towards infinity once more, but the introduction of new genres has come with its disadvantages.

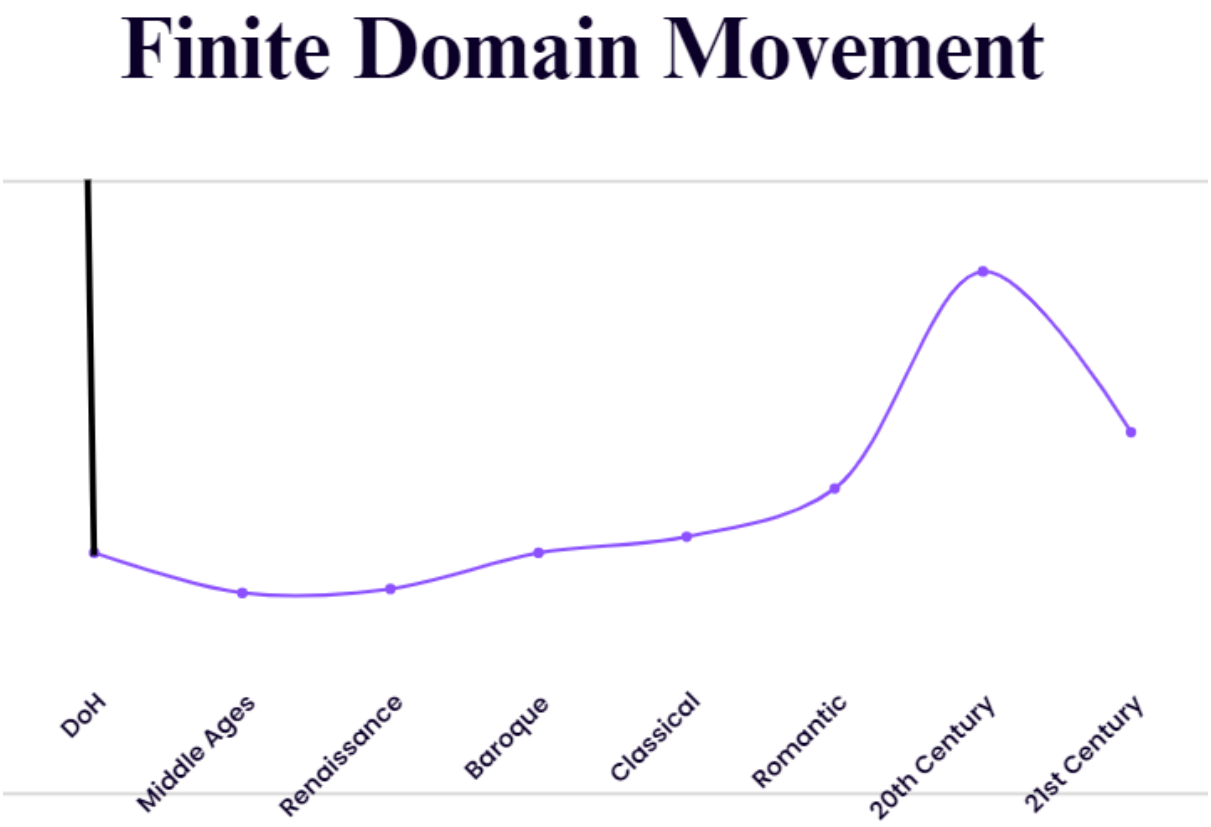
- Song structures are standardised, meaning artists are incentivised to create shorter songs with quicker 'hooks' to retain listeners. This involves making songs more repetitive, and therefore more memorable, and thus more likely to be listened to (creating revenue for artists). This has led to a more formulaic structure in popular music: shorter intros, early choruses, and concise, hook-heavy formats, designed to maximise streaming numbers and avoid causing the listener to be uninterested. The three minute pop song rule suggests that the ideal length for songs is three minutes, causing commercial tracks to shrink, reinforcing a constraint in how songs are crafted. Artists are presumed to create 'stream-friendly' songs, limiting experimentation with longer, more complex arrangements.
- There is an emphasis on harmonic simplicity and formulaic chord progressions. In many popular genres, especially pop, hip-hop, and electronic music, there's a reliance on simple, familiar chord progressions (e.g I-V-vi-IV). This creates a harmonic

similarity across many hits, driven by the desire for accessibility and mass appeal. These predictable patterns can become a constraint that limits harmonic diversity. Besides the recycling of chord structures, there is extreme tonal rigidity in modern music. Similar to the previous centuries, experimenting with tonality isn't encouraged, and much of mainstream music adheres to conventional tonality, rarely venturing into microtonality, unusual scales, or even key changes. Modulation is rare in very modern songs.

- There are tempo and rhythmic constraints too– more so than before. Due to the dominance of club music, pop, and hip-hop, certain tempos (e.g 120-130 BPM for dance music and 60-90 BPM for trap) have become industry standards. This can create rhythmic rigidity, as producers often use familiar beats and 'grooves' for specific genres, limiting rhythmic experimentation. As well as this, digital production tools often encourage a precise "grid-based" timing (similar to time signatures), which quantises rhythms and eliminates subtle timing nuances found in live performances. This results in a rhythmic monotony, where natural fluctuations and human error are minimised, leading to more mechanical, tightly controlled rhythms.
- Algorithms play a substantial part in constraining genres. Platforms like Spotify and YouTube rely on algorithms to recommend music, often based on specific genre labels, mood categories or popular trends. This can constrain artists to stick within narrow genre boundaries to ensure their music gets categorised in a way that maximises exposure. Artists may feel pressured to make music that fits specific playlists or algorithms to increase their chances of success. Algorithmic recommendations favour music that is familiar to listeners, pushing producers and musicians to adopt popular production trends (such as trap beats, auto-tuned vocals, and synth-heavy arrangements). This reinforces a cycle of repetition, limiting the diversity of musical textures and production techniques.
- The widespread use of Auto-Tune has created a standard for vocal perfection, effectively constraining natural variations in pitch. Many contemporary tracks use this tool not only for pitch correction but as a stylistic choice, leading to a uniform sound across genres like pop, hip-hop, and electronic music.
- Advances in digital production tools have made it easier to recreate certain sound palettes. Popular presets in virtual synthesisers or drum machines (such as the ubiquitous 808 kick drum in hip-hop) are used across countless tracks, limiting timbral diversity and creating a "same-sounding" landscape.
- Certain lyrical themes dominate mainstream music, often revolving around love, partying, or social status. These lyrical trends can act as constraints, especially for artists trying to break into the mainstream. Deviating from these thematic norms might be risky for artists seeking mass appeal. Not only do these themes limit originality, they also promote violence and normalise infidelity.

Therefore, with all the changes to the 21st Century outlined above, it can be concluded that (despite some of the changes favouring infinity) the regression to rigidity in western society suggests a *u-turn* of movement on the finite domain.

During this time (though the century has only just started), the overall movement on the finite domain is towards zero at a faster rate than ever before.



A graph to show the development of music on the finite domain spectrum over time. The purple line represents the movement of music under the restraints of human existence. The black line represents the movement of music before the restraints of human existence are applied. The grey line that borders the top of the graph is merely to provide a limit to the diagram, and is not a representation of infinity, as it cannot be quantified relative to the purple line. Thus, infinity cannot be seen or displayed on the graph.

This graph uses estimations and arbitrary units to display the progression of music across the finite domain, as a result of societal changes.

(5) The Future On The Finite Domain Movement

This section of the hypothesis does not only attempt to explain or understand the changes to music in our world, but also gives solutions to how we can adapt and utilise this understanding. This section also attempts to make sense of the changes, and provide reasoning for it. (This would be futile if it could not be applied and put into practice.)

The graph above shows that music has fluctuated over the centuries, yet (relatively) we have ended on a path towards where we started. It is important to note that this is all relative. Of course, our musical position now in society is not the same as it was when we were hunter-gatherers, but the balance between the opposing factors in today's society is equal to what it was at the dawn of humankind.

Visualise it like this:

- During the Dawn of Humans period, there was a restricted amount of instruments and dynamics in music (-2 points), however there were no time signatures, key signatures, tonal frameworks, desired chord progression, tuning systems, or desired structures in place (+6 points). This creates an overall 4 points.
- During the 21st Century, there are restricted song systems, restricted tonal frameworks, restricted harmonies, restricted structures, restricted tempo, restricted rhythms, and restricted requirements for successful music (-7 points), however there are a vast amount of instruments, digital tools, varied genres, platforms, experimental styles, obtainable pitches with technological assistance, composition technologies, musical education, incorporating themes, thematic lyrics, and potential for complex harmonies (+11 points). This creates an overall of 4 points.

(This method of evaluating opposing factors is highly subjective and not very empirical, but it still allows for the visualisation of this section of the hypothesis.)

Although it is clear that the 21st century has a lot more possibilities regarding music, it also has a lot of restraints. Therefore, given the point system, it can be regarded as being in a similar place on the finite domain to when humans began creating music, or at least it is heading that way.

As a whole, music has risen on the graph, peaked at the 20th century, and has now begun its rapid plummet towards where it started. However, it is important to ask ourselves the *extent* to which it will plummet. Furthermore, we must ask ourselves whether we will see music rise again, commencing another cycle, or see it deviate, and bypass the minimum value of possibilities we have ever seen in human history.

If the 21st century continues to apply constraints to music, it is likely that it will continue to plummet on the finite domain. However, assessing whether this is going to happen relies entirely on assessing why it *has* happened so far. According to the model, music was succeeding in its gain of possibilities, but something changed towards the end of the 20th century that provoked a complete change in music's figurative direction.

From my perspective, the factor that has significantly contributed to the change of music's direction in recent decades is *money* (including revenue, royalties, and overall financial gain). As we have explored, the purpose of music has changed along with the evolution of mankind, and in recent times, it has changed once again, from expressing individuality to heightening streams and gaining listeners, all with the main goal of financial success.

Music is a pathway to success and fame nowadays, given the restraints are followed precisely. There is a formula and a recipe for creating successful music that perhaps eradicates the personal input. Now, repetition and similarities in music are favoured over

originality and differences, causing a specific standardised structure to be developed for most songs.

Although some would argue that music is still used to express the individuality of an artist, it is important to evaluate the extent to which this is the *core* reason music is written. Although it is true that music allows artists to express themselves, it is not the *reason* music is written in most cases.

The musical industry's pathway to success entails creating songs that align with the listener's preference: short, standardised, and limited in harmonic creativity. If these preferences continue to tighten (as a result of technological advances in social media, for example), it is clear that music will also tighten in its possibilities, moving closer to zero on the finite domain.

Money, legacy, and fame have replaced creativity and individuality, suppressing the possibilities further. This differs entirely from other periods. However, it could be argued that it is similar to the Middle Ages, where music was written to serve religion and religious events. If this is true, then it provides evidence for the notion that the freedom of music is the factor that expands its possibilities, and thus, by limiting creative freedom in this century (in relation to music), the movement on the finite domain u-turns towards zero.

It is vital to understand the core misconception here. Some would argue that western society advocates for individual freedom more than it ever has before in history, and therefore the question arises whether this should increase music's possibilities. However, we must approach it from a rational perspective: although individual freedom has increased, the confidence and ability to demand music's change has become easier. With technological advances allowing for quicker communication and the spread of information, music can be experienced by all people in Western society at one time. This accelerates the demand for music's standardisation. People, especially youths, find themselves exploring social media more so as the days go by, and the consequences of this are a unified, subconscious view on music's requirements. With the attention span of the average Western person decreasing, music's constraints are tightened. There is a higher demand for short and simple music, with generic rhythmic patterns and minimal harmonic exploration.

Therefore, if technology continues to take over the globe (which it most certainly will), we can predict that music will become tighter in its restraints.

However, we will most certainly be required to merge with other cultures if we want music to succeed in its possibilities. The reintroduction of modes, chromaticism, atonal music, experimental music, dissonance, and microtones would re-expand music's potential. However, if we continue to travel down this path, it is likely the musical possibilities will become minimal.

Some cultures haven't experienced any changes in their musical system on their lifetime

Indian Classical (Hindustani/Carnatic) and Persian Classical music have maintained ancient raga/tala and Dastgah systems for over a millennium. Japanese Gagaku and Noh theatre, Indonesian Gamelan, Tibetan Buddhist chanting, and Aboriginal Australian music have similarly preserved their traditional structures, instruments, and spiritual significance for centuries. The common denominator in all of these cultures is not necessarily rigidity in terms of musical systems, but rather rigidity in music's purpose. It is harsh to blame Western

society for the ‘downfall’ of Western music without taking into account the changes in music’s purpose. It is through these changes that music has altered too over time. The approach to music, and how it is treated by a society, is a clear indication of how it will prosper over centuries to come. A society that exploits music to serve a purpose is a society that will find itself limited in its musical possibilities. A brand that specialises in one type of product is restricted to purely the possibilities that the product itself entails. If a brand desires more ideas and innovation in their products, they must first be willing to change their spectrum of production. The same occurs in music. Western society, specifically Europe, has evolved dramatically over the past centuries, and as a result, so has the constraints of music. However, when music no longer is required to serve a purpose, and different cultures unite from around the globe, the spectrum of music’s possibilities begins to grow exponentially. There is very little that can’t be done with music if human constraints *aren’t* applied. And there is an argument to be made that (with technological advances around the globe) music has the potential to *definitise*. The interrelated dimensions of music that were proved to finitise music could potentially be shattered by technology. It is unlikely that this will happen, given the desires of listeners. But nevertheless, there is a potential for music to be made infinite (or *definitised*). The US composer, John Cage, who wrote “4’33” also wrote a piece called “As Slow As Possible”, which won’t finish until the year 2640. The next chord change is due in 2 years. Therefore, is potential for music to possess an infinite length, but we begin to cycle back to my parameters of Auditory Practicality: the idea that, in this context, nobody is interested (at this moment in time) in listening to an extremely slow and long piece of music. However, this isn’t to say that this can’t change. If music has evolved so drastically up until now, it has every chance to evolve drastically in the future. Although, I would argue that music’s transformation into an incentivised industry, rather than a mode of communication and express (which it was not very long ago), will continue to restrict music for a very long time. In my opinion, it will take a global miracle or catastrophe to remove the borders that money creates around music. As the days pass, the borders encroach in on music’s potential, restricting not only its possibilities, but its capabilities. As humans, we are privileged enough to have harnessed science’s greatest gift to humanity, but we have incentivised it like every other aspect of our western, capitalist society. It is also a result of globalisation that the scale of this incentivisation is much greater than before. There is an argument to be made that music has *always* been incentivised, especially in the Baroque period, where composers were paid to write music for the royal court. However, this is negligible in comparison to how it is now. In the Baroque period, composers wrote music to express themselves, and the financial side of it was merely an extension of their musical talent. However, in the 21st Century, musicians are solely focused on achieving financial success with their music. Still, the argument remains that musicians couldn’t have survived without being financially successful with their music in the Baroque period (for example). However, the counterargument I would make is that the musicians nowadays who compose for pleasure are negligible in comparison to the musicians who compose it for global distribution. It is this exact inequality and imbalance (between composers who write to express themselves and those who don’t) that is the reason for music’s current position on the finite domain. Globalisation and the interdependence of music worldwide means that every imbalance is exacerbated. The notion of creating music for one’s own pleasure and to express themself is suppressed by the masses

of musicians and producers that release reams of music like it's nothing. This unfortunately masks every other aspect of musical creation.
I remain hopeful that music's current position on the finite domain will be ephemeral. But most of all, I remain confident that music will take control. There is something to be said about the concept of humans moulding music like it is clay. I have come to realise that perhaps it is *we* who are moulded by music. After all, music is science.

(6) Mathematical Proof

Musical Finitude cannot be proven mathematically, because it deals with converting subjective aspects of music to quantitative data. Not only is this difficult, but it's inconsistent too, disallowing for any valid model to be made. As I entered the depths of the topic, I began overwhelmed with the sheer scale of subjectivity that music entails. This increase of subjectivity calls for an increasing implication of parameters, however this caused the concluding value to become more invalid.

However, just because the hypothesis cannot be proven, it doesn't necessarily mean it doesn't stand true. It is not falsifiable, and therefore remains theoretical (though not empirical), allowing for further expansion and exploration.

During my exploration of finite domain movement (Auditory Evolution), where I discussed the evolution of Western music, I reached a conclusion at the end of each Western era, stating whether or not music was tending to zero or infinity at that point. This judgement is yet another example of subjectivity, given that I can't *prove*, but rather, *evaluate*. I am left to have my hypothesis gnawed at, given its lack of empirical evidence, or its overall lack of an empirical approach.

An example of how subjective the hypothesis is, and hence why it can't be mathematically proved, is the process I underwent to *attempt* to prove it.

My aim: to assess the extent to which music is not only finite, but minimal in its possibilities of combinations.

The Method I Used:

"Music" as a term is extremely subjective, so I decided to focus on a key feature of music: melodies. Already, this eliminates all the other features of music: harmony, structure, timbre, and so on. First, I had to *define* a melody. I extrapolated data from ten of the most popular songs of the past two centuries. I calculated an average melody length and pitch range. I also calculated the average rhythms used: crotchets and quavers. The proportions of these rhythms in the piece was not calculated. I then decided to substitute these values into different equations to try and calculate the different combinations of music. The number was extremely large, and tended to infinity. Given that it had proved musical finitude, but not its minimal combinations, I was advised to add more parameters. However, with more

parameters comes a greater lack of validity. The number itself was already drastically invalid, and so changing it further would prove futile in the grand scheme of the mathematical proof. Therefore, I concluded that musical finitude, specifically the idea about music being minimal in its possibilities, cannot be proven. Rather, it can only be theorised. Hence, this report.

In the end, I decided not to prove my hypothesis mathematically, but rather support it qualitatively. I have done this via the examples, case studies, and overall detail in this report.

(6) Conclusion

This hypothesis is simply an attempt to explore and predict the trajectory and journey of music. Under the restraints of our hands, it rests simply as clay does at the fingertips of a sculptor, thus, its combinations of possible statues have the potential to be boundless, but if we continue to disallow our fingers to bend, our options will become limited, minimal, and (at some point) non-existent. Furthermore, if we are not willing to even step up to the potter's lathe, then we can accept music's fate: the current version or progression of the statue will not alter, develop, or be completed.
Adapting to the right degree of plasticity can enhance our possibilities, and this is evident in the path we have already trodden. Our past *can* be repeated, and this isn't a notion we should shy away from.

This hypothesis is *not* a futile comment on the obvious nature of music. We are shrinking the right to express ourselves, in a world where freedom of expression is advocated for, more so than ever. On the surface, this is a controversial statement. However, beneath the facade of the musical potential this century appears to have, music is an inmate in our prison. When we learn to stop incentivising art forms, we will truly be able to express ourselves with science's gift, without fear of exhausting music.

There *are* boundless possibilities, but we have chosen not to see them.

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